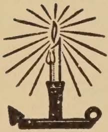
Philosophy Of Protective PAINT

Joseph Dixon Crucible Co.,
Jersey City, N.J. U.S.A.

PHILOSOPHY
OF
PROTECTIVE
PAINT



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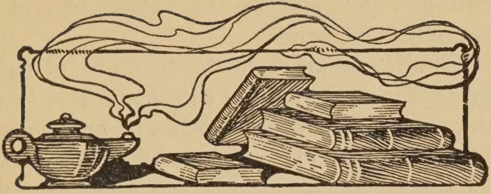


Introductory

PHILOSOPHY, we are told, is literally love of and search for wisdom; in actual usage the knowledge of phenomena, as explained by and resolved into causes and reasons. We therefore consider "Philosophy of Protective Paint" a very proper title for this pamphlet.

First of all, linseed oil is considered, its method of manufacture and drying properties, because of which it is converted into a tough and elastic substance, being briefly touched upon.

We are made to know the reason why a pigment is added and then comes the prime requisite—that the pigment shall be inert, not subject to chemical change, and the reason therefor.

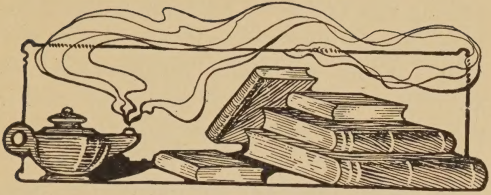
Following this comes a very interesting and fascinating part of the subject—the mathematics of the paint skin, which no one interested in protective paints should fail to carefully study and fully comprehend.

Of equal importance is the proper application of the paint and the fallacy of great spreading capacity.

Finally we are brought to know of the great importance of the physical properties of protective paint pigments, and especially the wide difference in graphite pigments. Fully, clearly, and beyond any question, we are brought to see and to know the reason why flake graphite with silica is the ideal pigment for protective paints, and we are shown the weaknesses of pure graphite and amorphous graphite paints.

To the man who has a personal interest in protective paints, as a means of preserving property, this booklet especially appeals.

JOSEPH DIXON CRUCIBLE CO.,
Jersey City, N. J.



NEARLY fifty years ago, alterations in the mining plant of the Joseph Dixon Crucible Co. at Ticonderoga, N. Y., resulted in the removal of a large amount of good machinery. It was necessary to store this out of doors, and to protect it from rusting, the superintendent began to paint it with a mixture of oxide of iron and linseed oil. The supply of oxide giving out, he thought to use some of the flake graphite which was a product of the plant. Two years after, examination of the paint showed that, though still intact, the iron paint had become exceedingly dry and brittle, while the flake graphite paint had to a wonderful extent retained its original toughness and elasticity, and on many of the pieces the paint remained in good condition for twenty-four years.

This Company acted upon the suggestion, and in nearly fifty years which have elapsed has seen Ticonderoga flake graphite come into the first position as a pigment for protective paints. We use today precisely the same material as was used in this trial so long ago, and never have found any cause to change our views as to its absolute superiority for this particular purpose. As the advertiser says, "There's a reason," and in the following pages we are going to tell the why of it, clearly and convincingly.

In order that our argumentative seed may fall in fertile soil, we wish to give some few facts concerning protective paints in general, whether the pigment is graphite or some other material.

Linseed Oil Generally the Vehicle of Protective Paints

It is probably true that at least 90% of the paint used for the protection of metal surfaces, subject to the attacks of climatic conditions, is linseed oil paint, as distinguished from paint made from asphalt or tar-like substances, dissolved in benzine or other very volatile solvents.

In a general way, linseed oil paints consist of a mixture of linseed oil, a solid pigment, and a preparation of metallic salts called driers, which are added only to increase the rapidity of drying.

Many attempts have been made, and are being made, to improve on linseed oil as a paint vehicle, but so far without any real degree of success. It is a fair statement to make that the good qualities any of the so-called substitutes may have, are almost entirely due to the linseed oil which is always contained in them. Much is said and written about the inferior quality of linseed oil. There is no doubt but that in passing through the hands of several middlemen, there is excellent opportunity for the quality of the oil to deteriorate. But where the manufacturer of paints, or the consumer, buys directly from the manufacturer, there is no difficulty whatever in securing linseed oil of the very highest quality.

Linseed oil is extracted from flaxseed under the combined action of heat and pressure, and the resulting product, after being properly settled, is the raw linseed oil of commerce. When this oil is spread out in thin films it begins to get "tacky" in two or three days, and then gradually grows harder until it finally loses all stickiness, and is then said to be dry. This drying is the result of absorption of oxygen, a process which converts the oil into a tough and elastic substance, very insoluble and adherent. In the case of raw oil this drying action is secured after from four to eight days. This is altogether too slow, since the chance of the paint coat being ruined by rain storms before becoming set is enormously increased, and for this reason driers are added.

Driers consist of combinations of metallic salts, such as red lead, with linseed oil, resins, or both. When these combinations, in which the oxygen is held rather feebly, are mixed with linseed oil, some of the oxygen is taken up by the oil, and in this manner the drying action is much hastened. When the salts are added to the oil while maintained at a relatively high temperature for a length of time, a product called boiled linseed oil is obtained, in which the drying action is approximately the same as if driers had been added cold to the raw oil. By either method, oil may be made to dry in as few as six or eight hours, where the raw oil alone requires as many days. It should be borne in mind, however, that extreme rapid drying is invariably accompanied by a loss of permanency, and we would warn against those paints which are warranted to dry in eight and twelve hours. Such rapid drying should be resorted to only in such special cases where it is understood that durability is to be sacrificed.

Linseed oil, when dry, adheres strongly to surfaces upon which it is applied, and even when used alone offers a certain amount of protection. But when so used the film is thin, and soon wears away under the influence of the elements, and the abrasive action of dust, cinders, etc. In order to make the film thicker, so as to furnish a greater amount of wear, a pigment is added. This consists of some solid substance, finely ground, and which experience has shown to be good for this purpose.

Pigments Should be Inert

One consideration in the selection of a pigment is its color, as paints are used for decorative purposes to a very much greater extent even than for those purely protective. But where the preservation of metallic surfaces is the object sought, then prime consideration should be given to the effect of the pigment so far as it aids in preserving the original elasticity of the dried oil, or in other words, the "life of the oil."

By increasing the thickness of the paint film, the particles of pigment protect the underlying portions of the oil, preserving its original elasticity and toughness. While one might think that a particle of one pigment would protect the oil as well as a particle of any other pigment of *the same shape and size*, yet in practise some pigments are found which are much more valuable than others.

A prime requisite is that the pigment shall be inert—that is, it shall not undergo any chemical change in use, because such change must result in a change of volume. The effect of such change of volume is easily understood when we consider that each particle of pigment is surrounded by an envelope of hardened oil. If the pigment particle increases in size, this envelope must eventually be ruptured; if it decreases in size, a void occurs between the pigment and the oil. In either case the film has become pervious, and so has lost much of its protective power.

But the matter of thickness of the paint film is most important and interesting, and we want to go into it with a good deal of detail.

We have before us the circular of a certain paint manufacturer, claiming as a superior merit that one gallon of his paint will give a good coating to 1200 square feet of surface. This is a very enticing bait and is eagerly taken by many persons, who do not give the matter proper consideration. We shall show clearly that such an argument instead of being favorable, actually condemns any paint for which such claim is made.

The cost of painting consists of the sum of two items, labor and material. The cost of labor may be anywhere from fifty cents to five dollars per thousand square feet, depending on the character of the surface. The cost of applying different paints, of approximately equal spreading capacities, should be about the same for any given surface. If anything, the paint which is spread out the furthest requires the most labor. But to make our example fair and simple we shall assume the cost of the paint to be one dollar per gallon and the cost of labor to be one dollar for twelve hundred square feet—so that if we spread the gallon of paint over 1200 square feet of surface the cost will be:

$1.00 for material
$1.00 for labor
$2.00 total cost

Note:—The labor cost of painting is extremely variable. It may be as low as 50c. per thousand square feet on flat roofs, with cheap and inexperienced men—or it may go as high as three or four dollars on bridges and buildings, where only skillful and careful men may be employed. The minimum price above is taken in order to make the comparison as favorable as possible to the paint spread at the 1200 square foot rate, because, as the labor cost increases, the comparison becomes more and more favorable to the paint spread at the 400 foot rate.

Now, on the other hand, suppose we take *three* gallons of paint instead of one and spread it over 1200 square feet; the cost will be:

$3.00 for material
$1.00 for labor
$4.00 total cost

But the coating in this case is three times as thick as in the first case, and this result has been secured at only twice the cost.

The above example is of itself sufficient to condemn paints of high spreading capacity, but there is more yet. As everybody knows, paints wear away in time and finally become so thin as to be no longer protective. If anyone was to offer a paint which was guaranteed to spread out over 2400 square feet per gallon, you would decline, saying it would form too thin a coating to offer any real protection. And yet when a paint that is spread at a 1200 ft. rate is *half worn out*, the remainder is then only as thick as a paint spread at a 2400 ft. rate. The thickness of a film spread at a 1200 rate is about 2/1500″ and one half of this is 1/1500″. The thickness of a film spread at a 400 ft. rate is 6/1500″ and when this film has worn to 1/1500″, then 5/1500″ of the original thickness has disappeared. So it is clear that by using a paint that covers only four hundred feet per gallon as against one that covers twelve hundred feet, we get a coating three times as thick, five times as durable and at only double the cost.

There is a limit, of course, to the thickness of paint films. Beyond a certain thickness the paint runs, or in drying, a firm skin may be formed on the outer portion while the interior portions are yet soft. This outer skin prevents access of oxygen to the underlying parts and drying may be much retarded. But paints which usually spread from three to six hundred feet per gallon, will, if of good quality, dry solidly throughout and give the best results.

Importance of Proper Application

Probably nine out of ten so-called failures of protective coatings are due to improper application, and of those failures a large percentage is due to the fact that many paints are difficult to apply. This difficulty may be that the paint drags under the brush, resulting in great unevenness in the thickness of the coating, or it may be because of the heavy specific gravity of the pigment that sagging occurs. In order to avoid this latter fault, the paint is brushed out so far as to make the coat exceedingly thin. Even with expert workmen these defects are decidedly a contributing cause of paint failures. Neither of these objections is present in graphite paints. Anyone using a genuine graphite paint for the first time wonders at the ease and certainty with which it is applied. The surfaces are easily and quickly covered, and because of the low specific gravity of the pigment, there is no sagging. This ease of spreading is a direct result of the lubricating quality of the graphite itself, and is the explanation of the large volume of pigment which may be incorporated in a graphite paint.

As a paint pigment, graphite is absolutely inert. It is not affected in the least by the action of the strongest acids or alkalies. To be sure, it is slowly consumed in the presence of oxygen at temperatures above 1000°

Fahrenheit, a condition to which it is of course not subjected in its use as a paint pigment. But there are other substances which are also inert, when used as a paint pigment, as much so as graphite, and of these, silica is an excellent example. It is not affected in the least by any chemical or physical influences to which the paint may be subjected, and particle for particle it will protect the oil exactly as well as graphite, *provided only that the particles are of the same shape and size.* But they are extraordinarily different in their physical properties, silica being hard, rough and transparent, while graphite is soft, unctuous and opaque. A paint made from pure silica will be somewhat difficult to apply, will drag and wear the brush rapidly. A paint made from pure (or nearly pure) graphite will spread easily, will not drag nor wear the brush. If the two paints are made of the same consistency, it will be found that in ordinary practise the one made from graphite will spread out, with the same effort, very much further than that made with silica as the pigment. And, provided that the particles of graphite are of the same shape and size as the silica particles, it is probable that the silica paint film will give the greater durability, *not because silica is the better pigment, but because the film is thicker.*

It is plain that we have here two most excellent pigments, possessing in the greatest possible degree those two most necessary characteristics, inertness and low specific gravity. But to be perfect each needs just that amount of improvement which the presence of the other affords. Just as mixtures of copper, zinc and tin give alloys of greater strength than any of the ingredients, so does a combination of silica and graphite give better results as a paint pigment than either used alone.

Simple as the matter may appear, imitators of Dixon's Silica-Graphite Paint have fallen into the error of thinking that all its good qualities were due to the graphite contained in it. And so, making use of amorphous and artificial graphites, have sought to discredit our pigment because it contains less graphite than theirs.

The facts are, that we have never called ours a "Graphite Paint." Our product has always been designated as "Silica-Graphite Paint." This is the name which appears on all of our labels, stencils and advertising literature. And it is Dixon's "Silica-Graphite" Paint which has won an enduring reputation for durability and efficiency.

All of the statements we have so far made, as to the value of graphite and silica as paint pigments, hold true whether the graphite is natural or artificial, crystalline or amorphous. But now to the truth previously stated, that a particle of silica will protect as well as a particle of graphite of the same shape and size, we will add another truth, which is, that one particle of graphite may protect better than another particle of graphite because it is of different shape and size.

As was said before, the chief functions of a pigment in a protective coating are to increase the thickness of the film and to protect the oil from destruction.

Under combined abrading and solvent action the exposed oil is gradually removed, uncovering the particles of pigment below. If the particles of pigment are harder and more resistent to wear than the oil itself, as they of course should be, they are only removed by an undermining action which is relatively slow. Referring to the accompanying cuts, Fig. 1 shows a particle of pigment surrounded by an envelope of oil. Fig. 2 is intended to show the particle after being split in two and also surrounded by an envelope of oil. It is perfectly plain that the removal of the two particles must

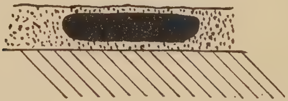


Fig. 1.

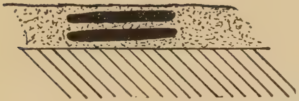


Fig. 2.

take a greater amount of time than when they were united, since the adhesion of almost double the amount of surface has now to be destroyed. From this is seen the importance of securing the greatest possible amount of *surface of pigments.* It is universally accepted that of two paints made with the same pigment, but pulverized very fine in one case and relatively coarse in the other, the one containing the fine pigment will be the more durable. This is so, not because the pigment is fine, but because

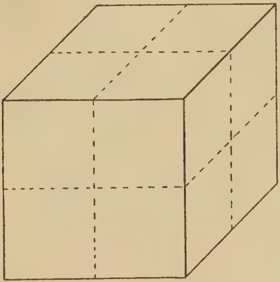


Fig. 3.

that for any given volume of pigment the total surface of pigment is greater.

Fig. 3 illustrates how a finer division of the particles results in an increase of surface.

The cube is cut by planes as indicated by the dotted lines into eight small cubes. It is seen that while the volume remains the same, the total surface has been doubled. But the cube may be divided in another way, see Fig. 4.

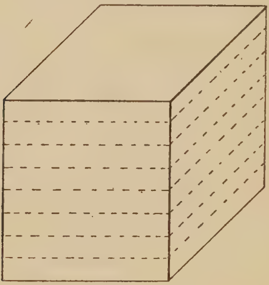


Fig. 4.

The seven planes along the dotted lines divide the cube into eight plates, each of the same volume as one of the small cubes in the first case, but each having a surface as compared to the surface of one of the small cubes as 20 is to 12, or almost twice as great. We also might express the same idea by saying that 12 volumes of the plates or flakes would give the same amount of protection as 20 volumes of the cubes. Now supposing we take a cube 1″ in dimension, and split it into 20 layers—the total area of the original cube is six square inches, the total area of the 20 plates is 44 square inches, or more than seven times as great. Again, imagine the original cube to be only 1/500″ in dimension and this to be split into twenty layers, each of course having a thickness of 1/10,000″. Such fineness of pigment as this is entirely beyond the limit reached in the case of other pigments than flake graphite. That we reach it is fully substantiated by the following evidence.

From our mines at Ticonderoga, N. Y., we produce the finest lubricating graphite in the world. As we prepare this graphite for the market it appears coarse, and is coarse by the ordinary methods of measurement, a large percentage standing on a 30, and nearly all standing on 60 mesh screen. But each particle is an exceedingly thin flake, seldom as thick as 1/1000″, and often too thin to be measured by a micrometer showing 1/10,000.″ The average thickness may fairly be taken from 1/3000″ to 1/5000.″ Now, when these particles are reduced so that all will pass through the very finest sieve, more than 200 meshes to the inch, it is inconceivable that the thickness of any of them can be greater than 1/10,000″, and is probably much less.

It must be understood that when a particle is found measuring 1/1000″ in thickness, it is simply one in which complete separation of the laminae has not occurred, and that the particle consists of ten or twenty or more layers. We have never been able to determine the ultimate thinness of these laminae, but do know that we find *flake after flake* which gives no evidence of thickness whatever when measured with a calliper accurate to 1/10,000″.

There is one other reason to present in explanation of the high value of graphite for a protective paint, and that is, what we may call resistance to wetting. Many are familiar with the experiment of making a perfectly dry needle float on the top of water, the reason being that the steel does not wet readily, and the strength of the surface film of water is sufficient to carry it. Graphite possesses this property to a remarkable degree. Indeed, one of the methods practiced for the separation of graphite from its impurities, is to allow the material to fall carefully on the smooth surface of running water. The impurities wet readily and fall through the water, while the graphite floats away on the surface.

This property gives to a graphite paint a peculiar quality, that of "water repellency" as it is called. This in connection with the other fact that corrosion does not occur except in the presence of water is a still further explanation of the excellent results secured by the use of graphite paints.

So far as we know ours is the only company making paint from a distinctly crystalline flake graphite. There are those who use Ceylon Plumbago which is crystalline but not flaky—while there are others who use the various grades of amorphous graphite, both natural and artificial. The business of this firm follows every ramification of graphite use, and every known grade and form of graphite passes through our hands. We are in a position to select and use that kind best suited to any particular purpose, and that we do select the best is sufficiently evidenced by the high character of the products of the Joseph Dixon Crucible Company.

We feel that the foregoing argument is sufficiently clear to convince, but we wish to summarize:

First.—A particle of silica protects as well as a particle of graphite of the same shape and size and is just as inert.

Second.—Graphite tends somewhat to thin coatings.

Third.—Silica counteracts the tendency of graphite to make thin coatings.

Fourth.—A combination of the two gives better results than when either are used alone.

Fifth.—Increasing the fineness of the pigment increases the durability of the film.

Sixth.—Crystalline flake graphite as contained in Dixon's Silica Graphite Paint is the finest of all graphite pigments.

DIXON'S
SILICA-GRAPHITE
PAINT

ONE QUALITY
FOUR COLORS

THE natural color of Dixon's Silica-Graphite Paint is dark gray. In addition to the natural color, we manufacture an Olive Green, Dark Red and Black.

We recommend no lighter colors than these, as the addition of coloring pigments other than to produce these colors lessens the wearing quality of graphite paint.

Joseph Dixon Crucible Co.

Works and Main Offices,

Jersey City, N. J., U. S. A.

HOUSE ESTABLISHED 1827.

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